Work and Energy
On-Level Seventh Grade Science
2011-2012

Description

Energy is not lost or used up, but can be transferred from one object to another by doing work. Work is done when an applied force results in movement of an object over a distance. The amount of force required to move the object is directly proportional to the object's mass and is explained by Newton's Second Law of Motion. Energy is required to produce the force needed to move the object, and the object's kinetic energy is changed when it is moved by work. Emphasis is on predicting how changing the size of the force and the distance over which the force acts relates to the amount of energy transferred. Students understand that energy is conserved.

Connections

Energy as it relates to force and motion also relates to living organisms. Transfer of energy from chemical energy to heat and thermal energy during digestion, as well as forces that affect motion in everyday life such as emergence of seedlings, turgor pressure (relating to plant vacuoles), and geotropism (caused by hormonal changes in the plant), will be covered in a later unit on cellular structure and function.

Enduring Understandings

1. Energy is transferred when work is done.
2. Work occurs when force is applied on an object and there is a displacement parallel to the direction of the force. No work is done unless there is a displacement parallel to the direction of the force.
3. Distance and displacement are not equal. Distance is the total path traveled and displacement is the difference between the start and end points. Only when travel is in a straight line are distance and displacement equal.
4. Energy is required to exert a force, and force is required to initiate or change an object's motion. Forces only exist as a result of an interaction between two objects.
5. The force required to move an object is directly proportional to the object's mass. As mass increases, the force required to move that mass also increases (Newton's Second Law).
6. When applied force changes, the energy of the object receiving the force changes.
7. Energy may be transformed or transferred, but is never lost.

Essential Questions

1. What is work and how is it calculated?
2. How is distance different than displacement?
3. What factors affect how much work is done?
4. What is force?
5. How do changes in force affect work, energy and motion?
6. How is energy transferred?
7. What does it mean to conserve energy?

Essential Concepts and Skills

By the end of the unit, the student is expected to:

1. distinguish between distance and displacement
2. measure displacement and calculate work
3. classify examples as work or non-work
4. predict how changing the energy transferred to an object would change the object's force
5. predict how changes in force and distance affect the total amount of work done
6. explain variables which change the direction of motion
7. justify why energy is changed or transferred but never lost

What do students typically have as misconceptions?

1. The terms "energy" and "force" are interchangeable.
2. The motion of an object is always in the direction of the net force applied to the object.
3. The terms distance and displacement are synonymous and may be used interchangeably

Preconception Survey

1. What is work?
2. Are force and energy the same? Explain.
3. What happens to energy when a moving object comes to a stop?

Formative Assessment Items

1. Justify why some real-world examples show work and some show non-work
2. Measure displacement; then, given force, calculate work using real-world scenarios to prove the difference between work and non-work
3. Explore variables that affect the direction of motion after a force is applied
4. Illustrate and describe how energy is transferred when work is done

TEKS Covered

7.7 Force, motion, and energy. The student knows that there is a relationship among force, motion, and energy. The student is expected to:

A) contrast situations where work is done with different amounts of force to situations where no work is done such as moving a box with a ramp and without a ramp, or standing still. ***Supporting Standard-Category 2***

B) illustrate the transformation of energy within an organism such as the transfer from chemical energy to heat and thermal energy in digestion.

C) demonstrate and illustrate forces that affect motion in everyday life such as emergence of seedlings, turgor pressure, and geotropism.

6.8 Force, motion, and energy. The student knows force and motion are related to potential and kinetic energy. The student is expected to:

A) compare and contrast potential and kinetic energy ***Supporting Standard-Category 2***

C) calculate average speed using distance and time measurements ***Supporting Standard-Category 2***

D) measure and graph changes in motion ***Supporting Standard-Category 2***

6.9 Force, motion, and energy. The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed, it just changes form. The student is expected to:

C) demonstrate energy transformations such as energy in a flashlight battery changes from chemical to electrical energy to light energy ***Supporting Standard-Category 2***

Vocabulary

mass, force, work, energy, Kinetic Energy, Potential Energy, displacement, chemical energy, mechanical energy, thermal energy